INMS concept & vision

Science in support of international nitrogen policy development

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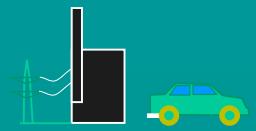
Centre for Ecology & Hydrology, Edinburgh

Towards INMS Plenary
Lisbon
27 April 2015

The Nitrogen Snowball

- Joined up management of the nitrogen cycle to strengthen the common cause between environmental, food & energy security challenges
  - What would a global science policy support process for nitrogen look like?
  - What are the issues to connect?
  - What are the main, research, demonstration and communication challenges?
- Why should the world be talking nitrogen?

Simplified view of the Nitrogen Cascade



High temperature combustion & industry

Fertilizer manufacture

Crop biological nitrogen fixation

Intended N flow

Unintended N flows

N form in the cascade

Environmental concern from N_r

Greenhouse gas balance

Stratospheric ozone loss

Nitrous Oxide (N_2O)

Tropospheric ozone formation

Urban air quality

Particulate Matter

Nitrogen oxides (NO_x)

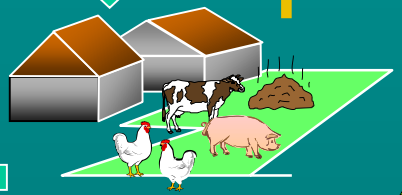
Ammonium nitrate in rain (NH_4NO_3)

Ammonia (NH_3)

Further emission of NO_x & N_2O carrying on the cascade

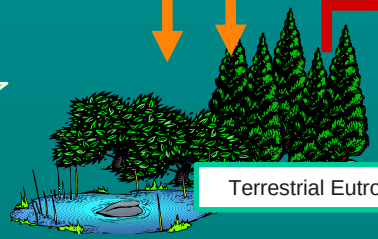
N_r

Crops for food & animal feed



Livestock farming for food

N_r in manure



Natural ecosystems

Terrestrial Eutrophication

Eventual denitrification to N_2

Soil acidification

Leached Nitrate (NO_3^-)

Nitrate in streams, groundwater & coastal seas

Freshwater Eutrophication

Marine Eutrophication

The European Nitrogen Assessment

Sources, Effects and Policy Perspectives

Edited by

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Jan Willem Erisman

Gilles Billen

Albert Bleeker

Peringe Grennfelt

Hans van Grinsven

Bruna Grizzetti

CAMBRIDGE

COMMENT

ENVIRONMENT ... Deer...

BIOTECHNOLOGY Biohackers take biology into the garage p.167

ECOLOGY Libyan revolution might protect bluefin tu... with trawlers grounde... Meer, ...

Vervuiling met stikstof kost miljarden

Nitrogen taint alert

Warning over nitrogen footprint

Pollution à l'azote : une lourde facture pour l'Europe

...cisely than this would be cleaner, reduce odour and emit less ammonia.

Too much of a good thing

Curbing nitrogen emissions is a central environmental challenge for the twenty-first century, argue **Mark Sutton** and his colleagues.

Nature 14 April 2011

Farming

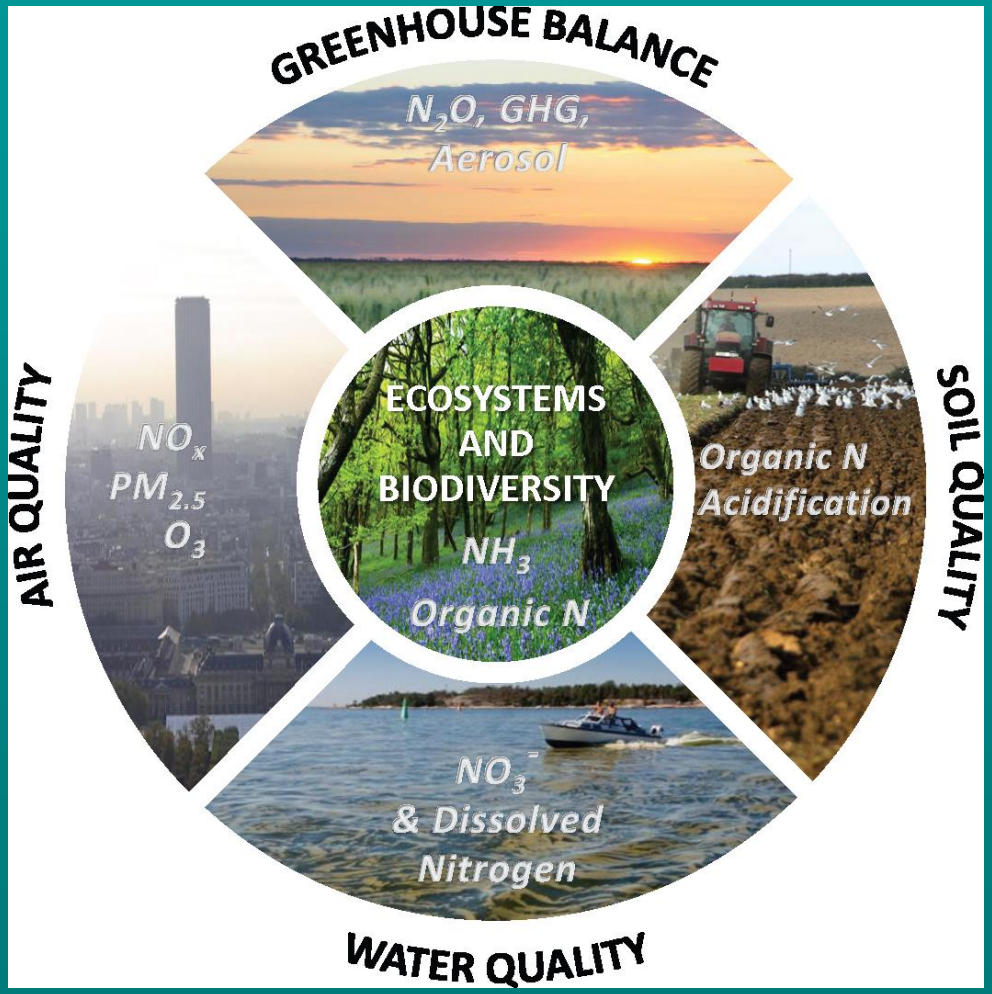
Union defends use of nitrogen in high-octane climate change debate

www.nine-esf.org/ENA

Five key threats

The WAGES of
too much nitrogen

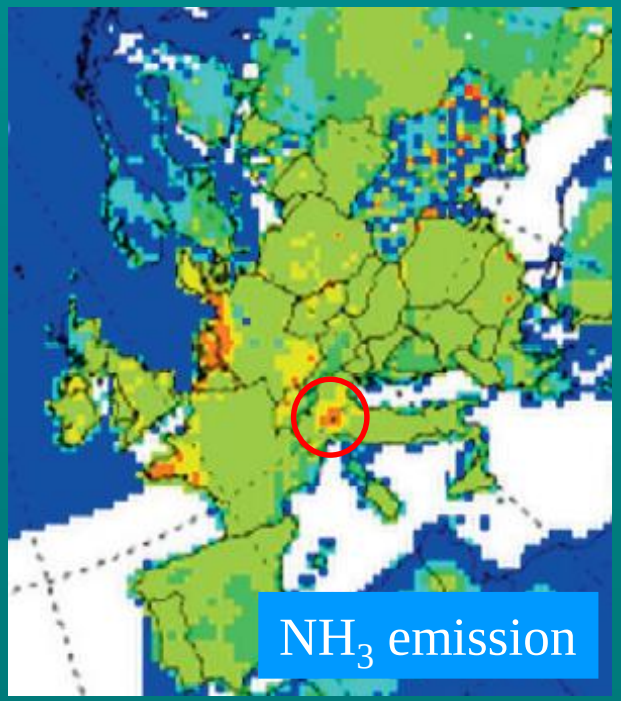
Water quality
Air quality
Greenhouse balance
Ecosystems
Soil quality



European Nitrogen Assessment, 2011 & Our Nutrient World, 2013

Ammonia contributes substantially to particulate matter (PM) concentrations

- Reduced visibility
- Human heath impacts



Parma, Emilia Romagna, Italy

The Big Idea

- A science support process for international policy development on nitrogen.
- ***Examples of science support***
- IPCC – but not the best example?
- CBD – INI provides the N indicator for CBD.
- Others, LRTAP, GPA.
- We can all think of examples and should learn from them.

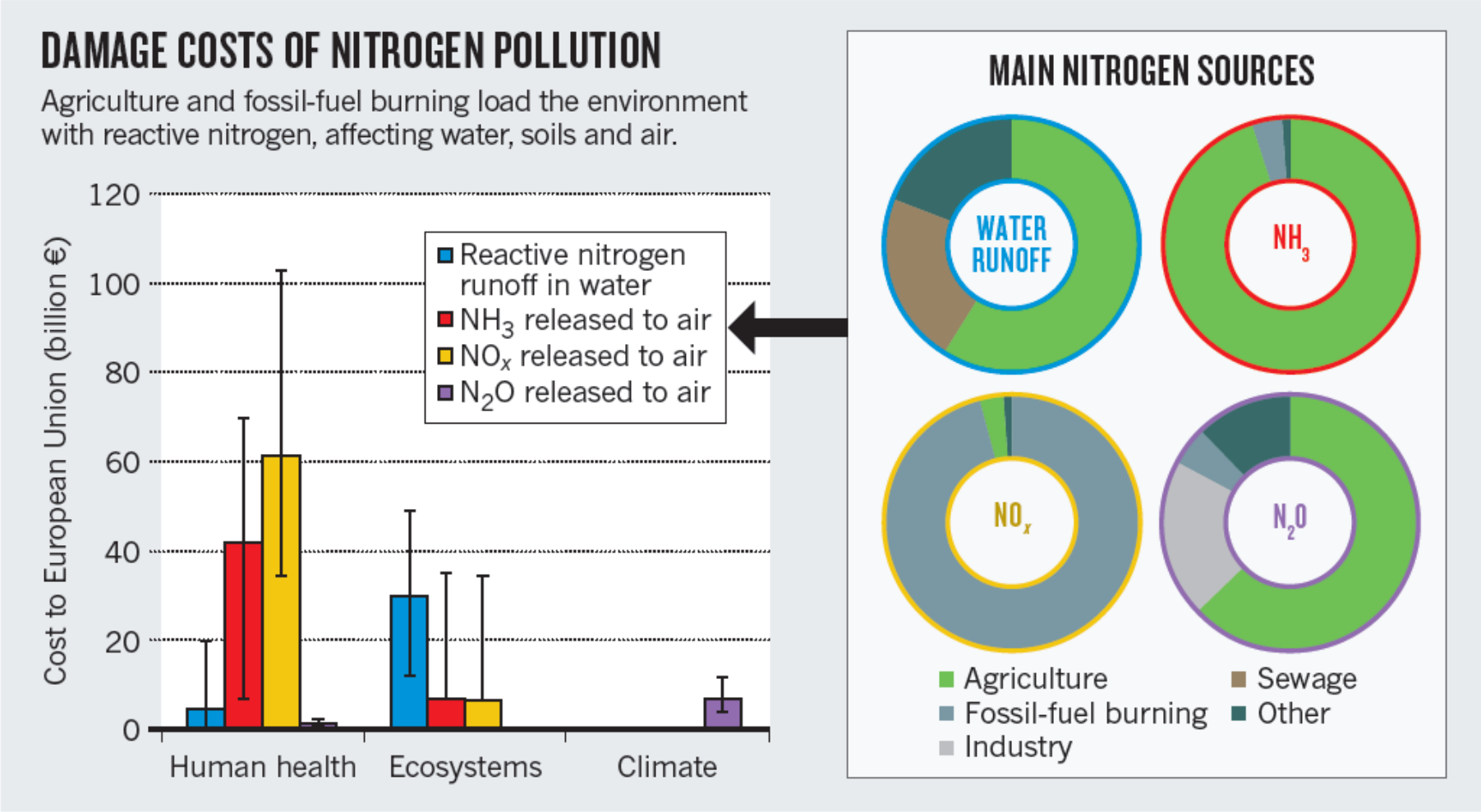
What INMS is not...

- **It is not a policy process.**
- However, discussing science support for policy has interaction with policy processes
- It may stimulate thinking by governments of what they want or don’t want.

Elements of INMS

- Nature and location of major nitrogen sources and flows
- Nitrogen benefits and nitrogen threats
- Capability to deliver this information, with integrated models, cost benefit analysis, development of performance indicators
- A combination of global analysis and regional demonstration
- Successes, barriers to change, and how to overcome those barriers.

Nitrogen Damage Costs & Sources



EU Damage cost: 70 - 320 billion € / year

Nature 14 April 2011

UN says fertiliser crisis is damaging the planet

Scientists urge rich world to halve its meat consumption

The shape of nitrogen to come

An analysis reveals the huge impact of human activity on the nitrogen cycle in China. With global use of Earth's resources rising per head, the findings call for a re-evaluation of the consumption patterns of developed societies.

Nature doi:10.1038/nature11954

More environment-friendly nutrient use could save $170bn a year

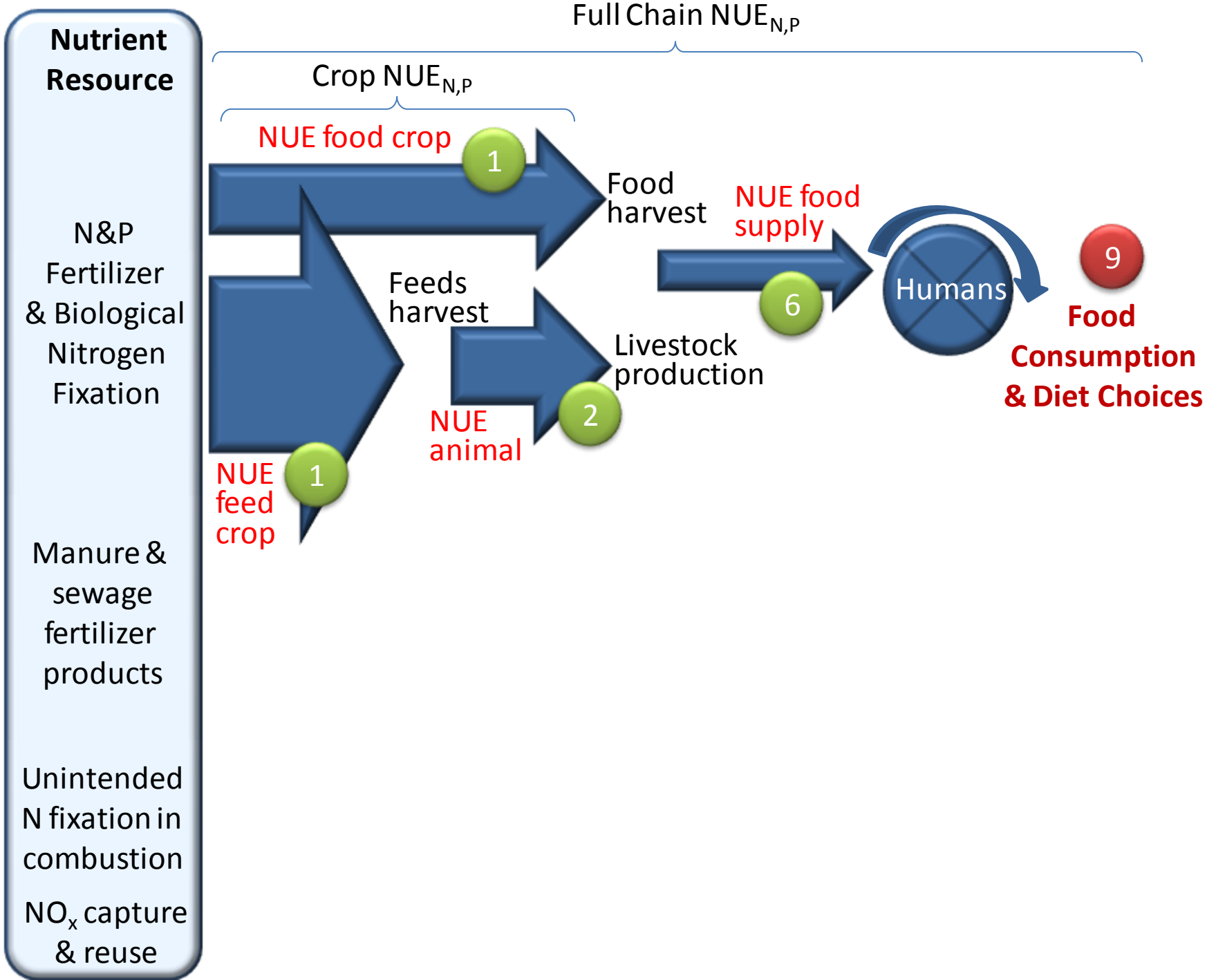
18 Feb 2013: *Independent , Guardian, Herald Tribune, Times of India* and **300 articles worldwide**

Global Overvie Nutrient Management

Our Nutrient World

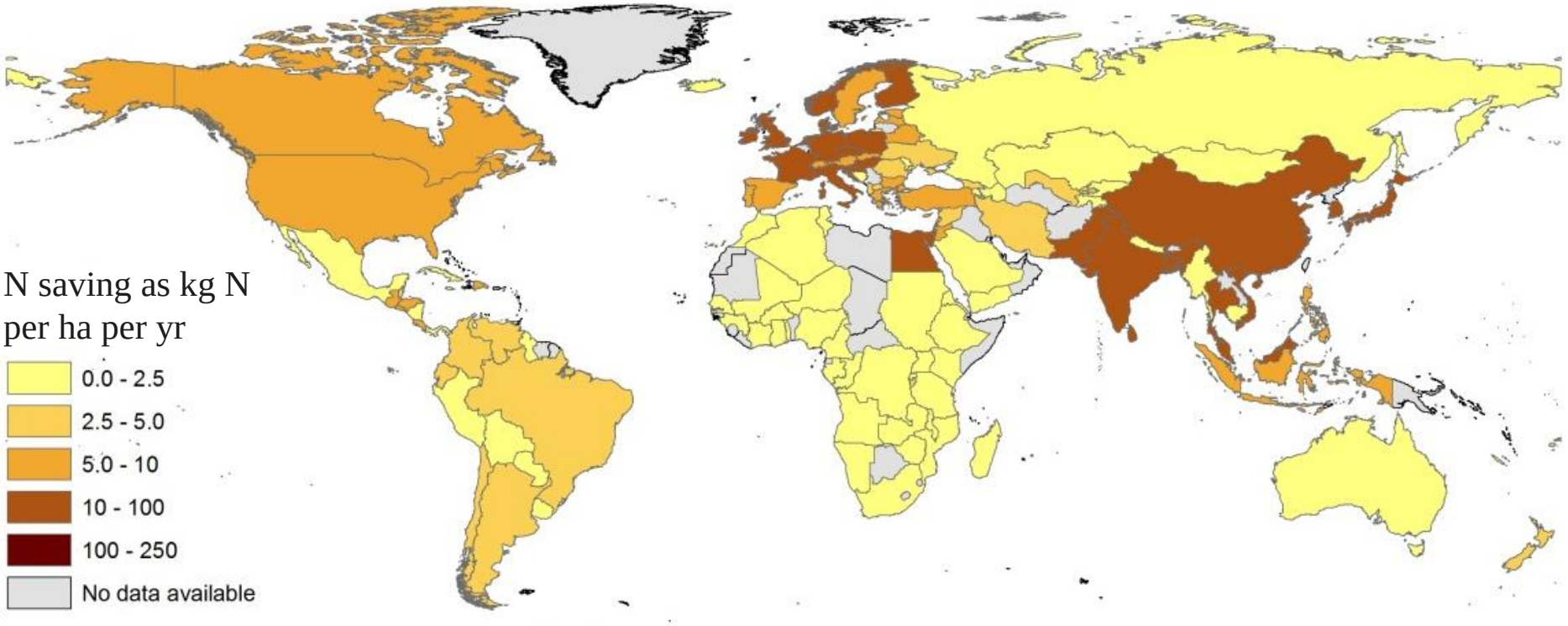
The challenge to produce more food and energy with less pollution

Prepared by the Global Partnership on Nutrient Management in collaboration with the International Nitrogen Initiative


Nutrient Resource
N&P Fertilizer & Biological Nitrogen Fixation
Manure & sewage fertilizer products
Unintended N fixation in combustion
NO_x capture & reuse
Full Chain $NUE_{N,P}$
Crop $NUE_{N,P}$
NUE food crop
1
Food harvest
NUE food supply
6
Humans
9
Food Consumption & Diet Choices
Feeds harvest
Livestock production
2
NUE animal
NUE feed crop
1

“20:20 for 2020”

20% better NUE: saving 20 Mt N per yr by 2020

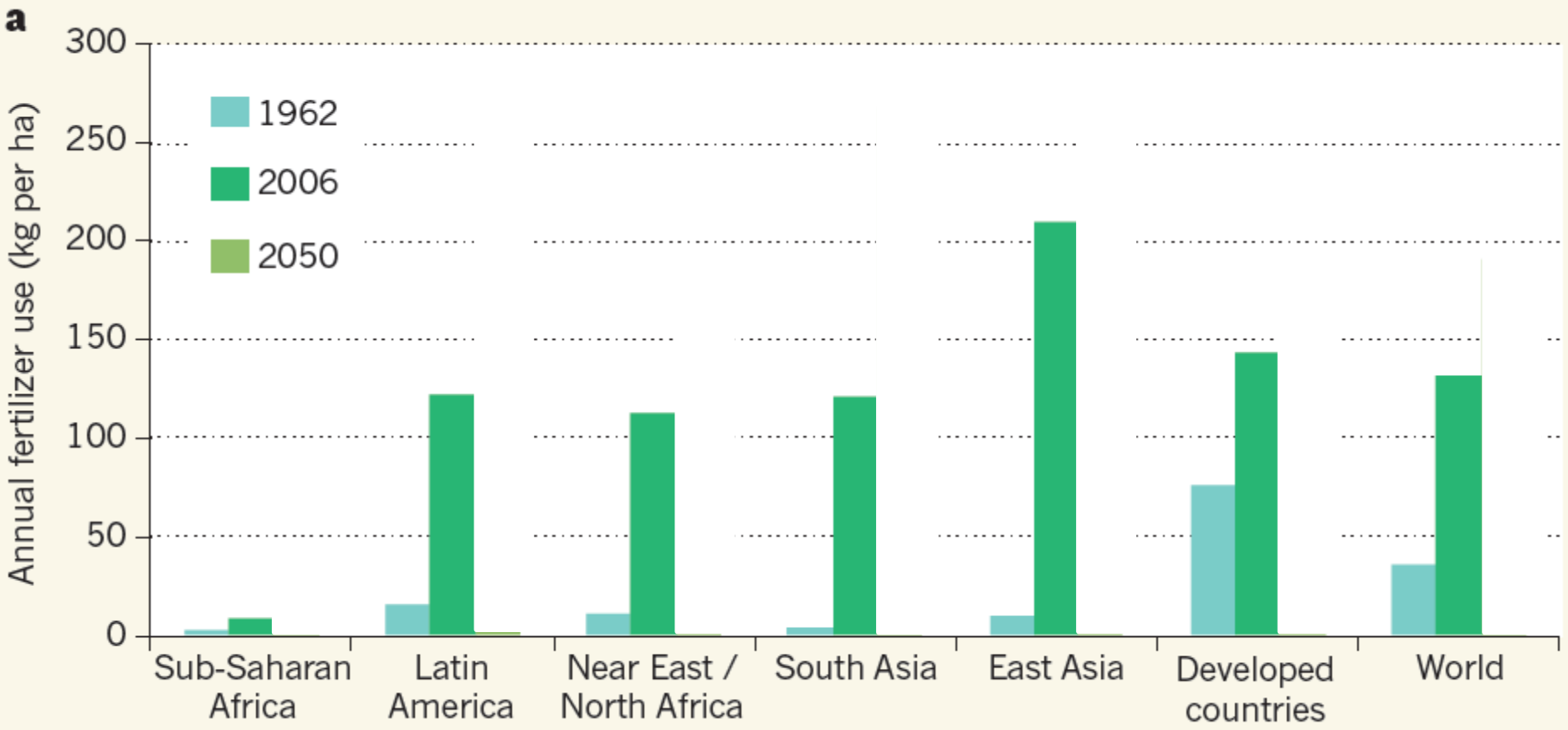


Bottom line for the Green Nutrient Economy ($billion/year)

Net Benefit 170= Fert Saving 23 + Env+Health 160 –Implementation 12

Past change – future risks

Global fertilizer use



Sutton and Bleeker *Nature* 2013
based on FAO projections

THE TIMES

Scotland Edition

Friday April 25 2014 | thetimes.co.uk | No 71180

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- **Halving EU meat & dairy intake would reduce N pollution by 40%**
- **NUE of the food system increases from 22% to 44%**

Raise taxes on meat to turn us into demitarians, says UN

Ben Webster Environment Editor

Extra taxes could be imposed on meat to deter families from buying it, according to a United Nations task force which recommends halving consumption of meat and dairy products to reduce pollution.

Britain's livestock farmers would suffer a "severe" loss of income from such a change in diet but there would be environmental benefits, including less pollution of the air, water and soil, and lower greenhouse gas emissions.

A team of scientists advising the United Nations Economic Commission for Europe (Unece) studied ways of reducing nitrogen pollution from chemical fertiliser and manure.

The task force on reactive nitrogen concluded that if everyone in the EU became "demitarian" — halving the amount of meat and other animal products consumed — it could reduce greenhouse gases from agriculture by 25 per cent to 40 per cent and nitrogen emissions by 40 per cent.

It would also cut the risk of heart disease and cancer by bringing consumption of saturated fats down to within levels recommended by the World Health Organisation.

The task force's report, published today, will inform negotiations between governments over tightening the EU emissions directive and the Unece's convention on cross-border air pollution. The scientists found that beef was the worst meat for environmental impact, causing 25 times more nitrogen pollution per unit of food protein than cereals. For pig and poultry meat, eggs and dairy, the pollution was 3.5 to 8 times that of cereals.

The team questioned whether people would be likely to cut consumption of meat simply by being better informed. They suggested that tougher measures, such as new taxes, might be more successful in changing behaviour.

They conclude: "A more direct policy intervention could be that of making meat and dairy products more expensive, either by direct taxation or by taxing the environmental effects."

The report admits that "the effects on the livestock sector will most likely be severe". Some farmers would be able to switch from rearing animals to planting cereals, but others with land less suitable for crops, particularly in Scotland and Wales, would suffer loss of income.

Reducing meat consumption would free "large areas of agricultural land in the EU" because much less land would be needed for grazing and for growing crops to feed to livestock. The report says the land could be used for growing biofuels to replace fossil fuels. Professor Mark Sutton, from the UK's Centre for Ecology & Hydrology and co-author of the report, said: "Adopting a demitarian diet across Europe would reduce nitrogen pollution levels by about 40 per cent which is similar to what could be achieved by adopting low-emission farming practices."

He acknowledged that reducing consumption in Britain would have limited impact on global emissions because countries such as China and India were increasing their consumption.

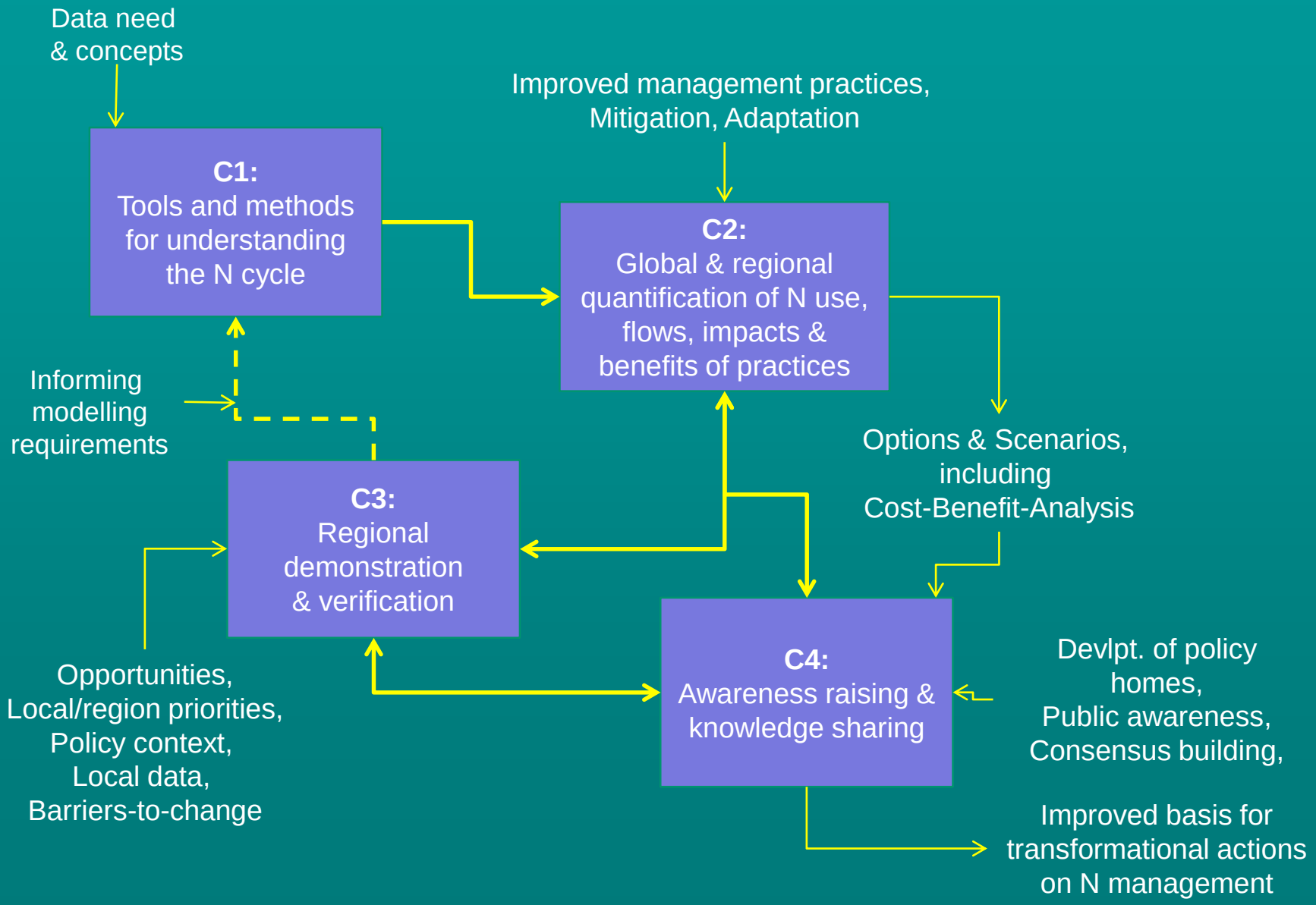
Dr Diane Mitchell, the National Farmers' Union chief environment adviser, said: "Eating less meat is a simplistic solution to what is a highly complex situation. The livestock and dairy sectors are already doing much to tackle their footprint.

"Some of this land can only be used for pasture and goes some way to protecting our wonderful countryside."

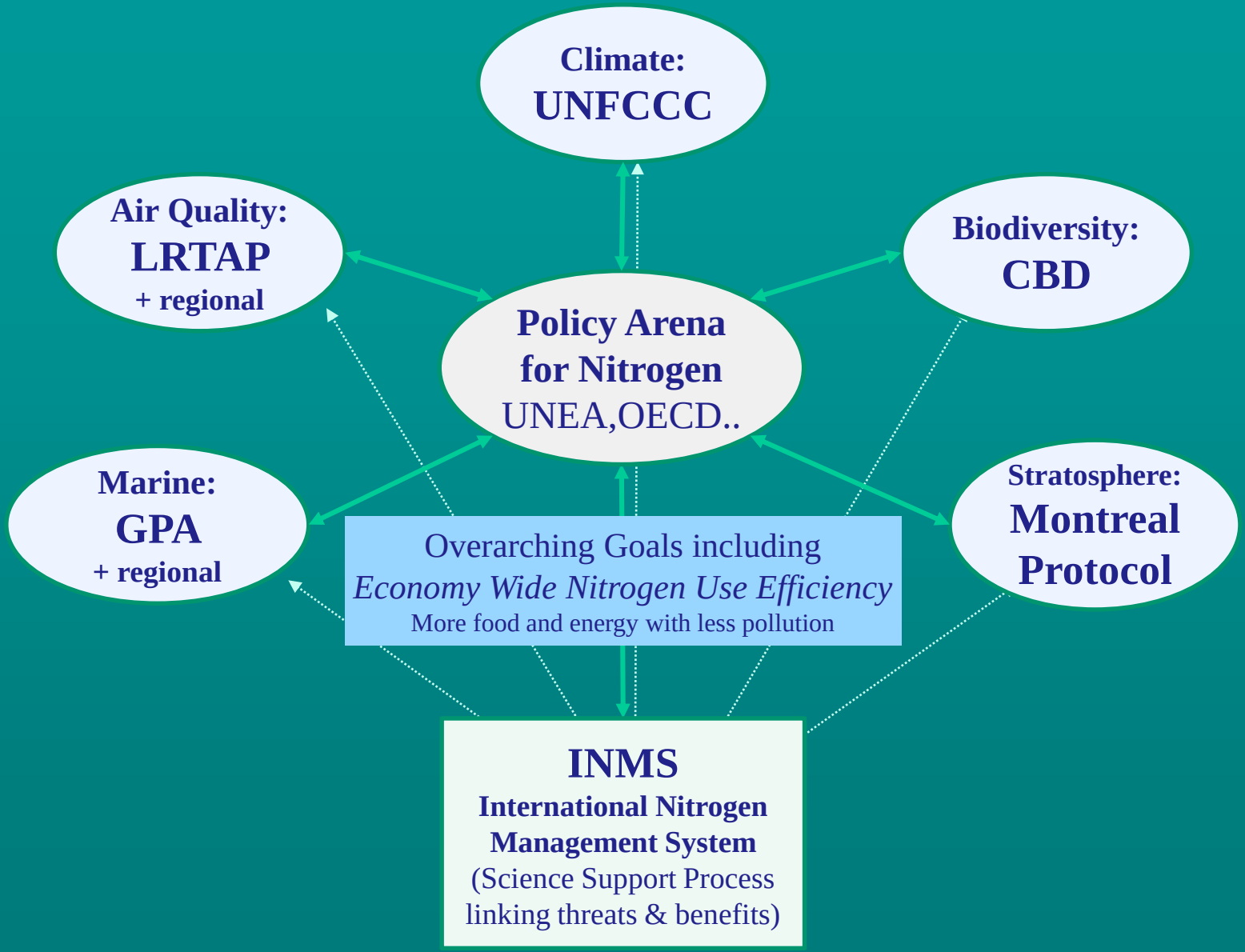
1GM 1GM

Nitrogen on the Table
Westhoek et al., 2014

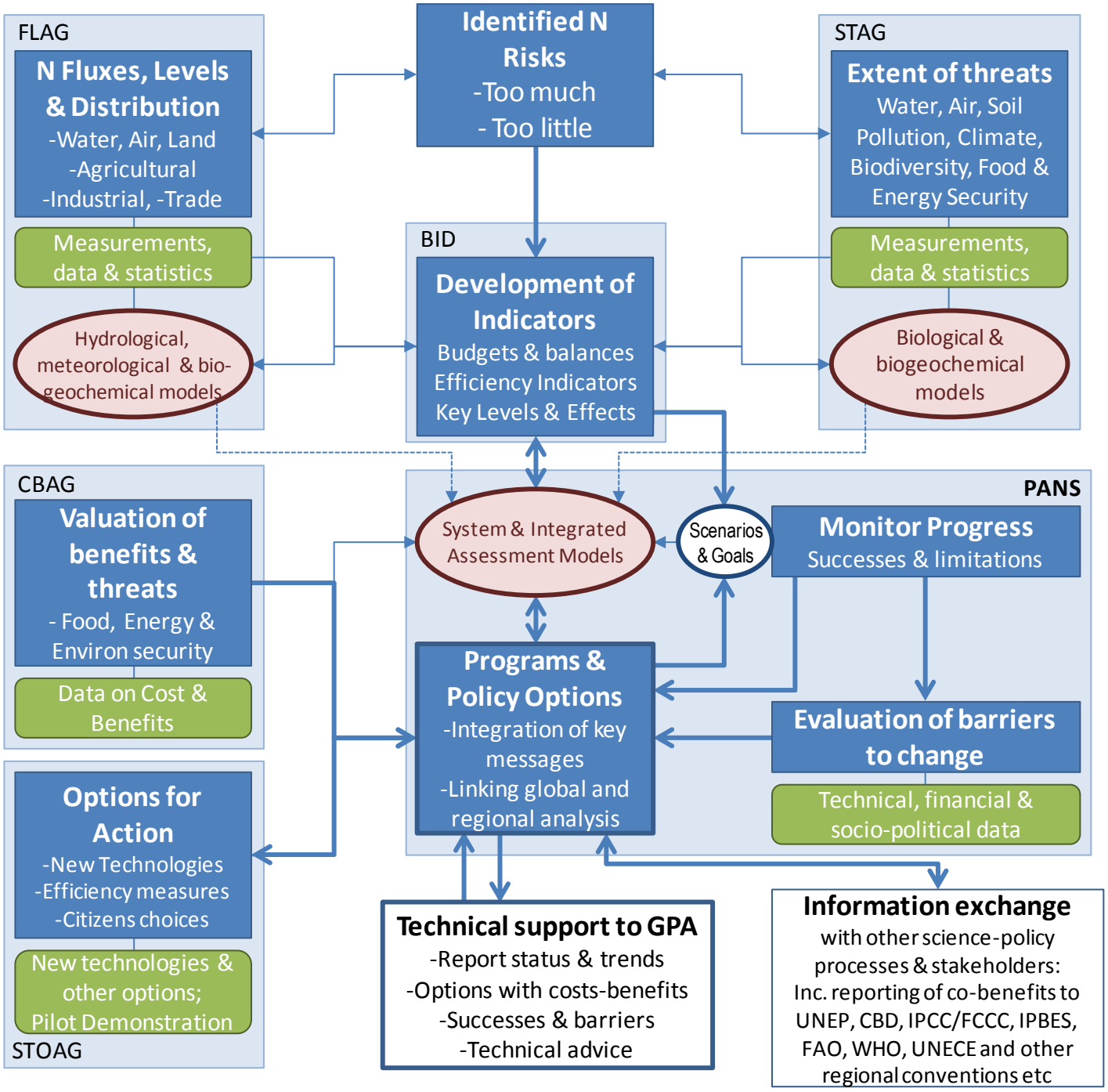
GEF/UNEP project towards the International Nitrogen Management System ('Towards INMS')



Linking International Nitrogen Policy Frameworks



Toward the International Nitrogen Management System (INMS)



GPA:
Global Programme of Action for the Protection of the Marine Environment from Land-based Activities

Process towards 'Towards INMS'

- The foundations of Rome in only 3 years
  - General concepts agreed and PIF drafted 2012-2013.
  - Extensive feedback and engagement from GEF Sec and STAP.
  - Final PIF approved April 2014.
  - Signed contract for Project Preparation Grant March 2015
- Lisbon: Plenary meeting
  - Testing ideas, extending community, preparing for paperwork
- Next Steps
  - Project submission this summer
  - Seeking GEF final approval Autumn 2015
  - Project Running 2016-2019